TMDL Development for Dissolved Oxygen and Nutrients for Bayou Lafourche Subsegment (020401) in the Barataria Basin, Louisiana

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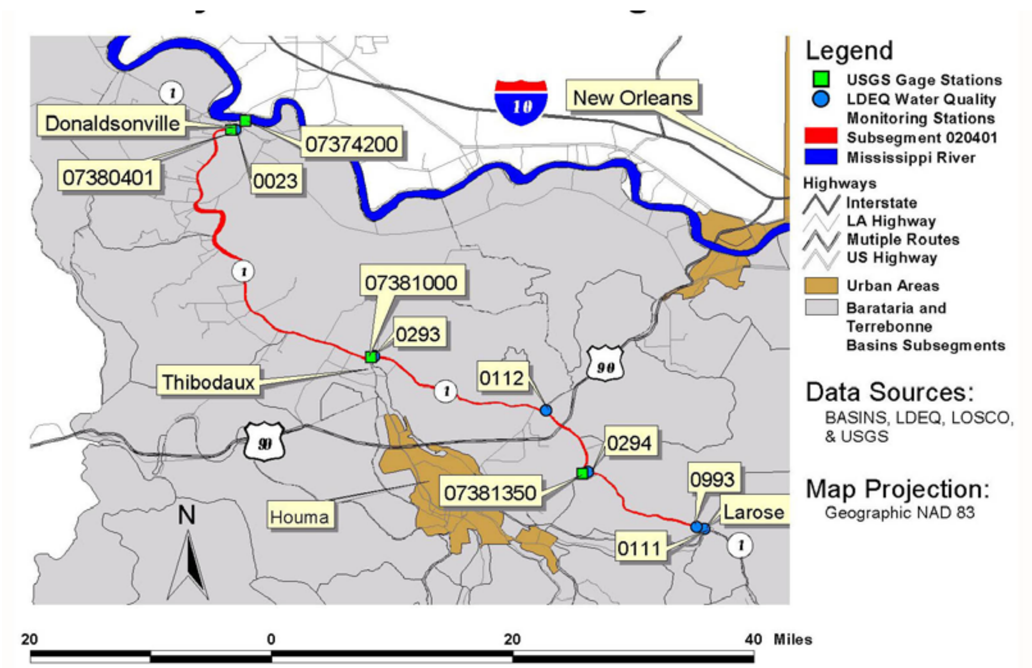
Fact Sheet

Bayou Lafourche Subsegment 020401, in the Barataria Basin, Louisiana, has been identified as not meeting water quality criteria for dissolved oxygen (DO) and nutrients. The water quality standard for DO in this subsegment is 5 milligrams per liter (mg/L). Louisiana has no numeric standards for nutrients in waterbodies but does have a narrative standard which requires that the naturally occurring range of nitrogen-phosphorus ratios be maintained. In response to the inclusion of this subsegment on the Modified Court Ordered 303(d) list, TMDLs were been developed for DO and nutrients.

Subsegment 020401 is located in the Barataria-Terrebonne National Estuary in southeastern Louisiana and extends from Donaldsonville to the Intracoastal Waterway at Larose. This subsegment of Bayou Lafourche is approximately 69 miles long and has a drainage area estimated at 10 square miles. The primary source of flow through Bayou Lafourche is provided by the Mississippi River as pumped through the Walter Lemann, Sr. Pumping Station at Donaldsonville at an average flow rate of 200 cubic feet per second (cfs). Land use in the subsegment is primarily agricultural (sugar cane cultivation) and urban/residential. There are numerous point source discharges, but they are typically small sanitary wastewater discharges.

Figure 1. Monitoring Station Locations in Bayou Lafourche Subsegment 020401



For the purpose of this TMDL, nutrients included total nitrogen (organic nitrogen, ammonia nitrogen, and nitrite plus nitrate nitrogen) and total phosphorus (TP). An evaluation of the nutrient ratio was performed on water quality data from the Bayou Lafourche monitoring stations. The calculated ratio was determined to be about 11:1, which is supported by available reference stream data.

A water quality model (LA-QUAL) was used to simulate DO, carbonaceous biochemical oxygen demand (CBOD), ammonia nitrogen, and organic nitrogen in the subsegment. The model was set up and calibrated using intensive survey data collected on September 23, 2003, and monitoring data and other information collected by the U.S. Geologic Survey (USGS) and Louisiana Department of Environmental Quality (LDEQ). The projection simulations were run at critical flows and temperatures to address seasonality as required by the Clean Water Act. The modeling in this study was consistent with guidance in the Louisiana TMDL Technical Procedures (LTP) manual.

The projection simulation results were used to develop a TMDL for oxygen demanding substances (CBOD, ammonia nitrogen, organic nitrogen, and sediment oxygen demand [SOD]) under the following scenarios:

- Scenario 1 – Current loading scenario, including all point sources, nonpoint sources, and natural background contributions;
- Scenario 2 – Modified loading scenario, as necessary to meet the 5.0 mg/L DO standard, through the increase/reduction of all existing loading (point sources, nonpoint sources, and natural background contributions) until the DO standard is met;
- Scenario 3 - Modified nonpoint source loading scenario, as necessary to meet the 5.0 mg/L DO standard, through the increase/reduction of all existing nonpoint source loading and natural background contributions until the DO standard is met;
- Scenario 4 – Modified flow scenario, utilizing a minimum flow (Scenario 4a) to achieve the 5.0 mg/L DO standard in the extant model developed under the first three scenarios, and a projected flow of 1,000 cfs for the subsegment without the fixed weir at Thibodaux and increased cross-sectional areas due to anticipated dredging (Scenario 4b); and
- Scenario 5 – Loading evaluation scenario, utilizing the extant model developed under the first three scenarios that demonstrates the relative impact of various loading through the elimination of all point source loading (Scenario 5a) and elimination of all nonpoint source loading (Scenario 5b).

Calculated Load Allocations (LA), Waste Load Allocations (WLA), Margin of Safety (MOS), and TMDLs for Scenarios 2, 4a, and 4b are presented in the following table. The largest loading to Subsegment 020401 is the constituency of waters diverted from the Mississippi River. For purposes of this TMDL, the constituency of the Mississippi River waters is considered to be a nonpoint source loading.

Calculated Load Allocations, Wasteload Allocations, Margins of Safety, and TMDLs under Scenarios 2, 4a, and 4b for Summer and Winter Conditions

Load Description	Summer (May-Oct)			Winter (Nov-Apr)		
	Scenario			Scenario		
	2	4a	4b	2	4a	4b
Current Point Source Loadings at Critical Conditions (kg/d of UOD)	533	533	533	396	396	396
Current Nonpoint Source Loadings at Critical Conditions (kg/d of UOD)	3,053	3,053	3,053	3.053	3,053	3,053
Maximum Nonpoint Source Loadings at Critical Conditions (kg/d of UOD)	20,009	835	108,666	31,550	810	157,786
Point Source WLA (kg/d of UOD)	533	533	533	396	396	396
Nonpoint Source LA (kg/d of UOD)	17,955	835	97,746	28,355	810	141,968
10% MOS (kg/d of UOD)	2,054	0	10,920	3,195	0	15,818
Assimilative Capacity (kg/d of UOD)	20,542	1,368	109,199	31,945	1,206	158,181
Reserve Capacity (kg/d of UOD)	14,902	0	94,693	25,302	0	138,915
TMDL (kg/d of UOD)	20,542	1,368	109,199	31,945	1,206	158,181
TMDL (lbs/d of UOD)	45,287	3,015	240,739	70,426	2,658	348,724
% Reduction in Nonpoint Source Loading Required	0	0(1)	0	0	0(1)	0
% Reduction in Point Source Loading Required	0	0	0	0	0	0

(1) Nonpoint source loading reduction results from headwater flow reduction, thus no reduction of nonpoint source loading is required along the 108 kilometers of the bayou subsegment.
kg/d = kilograms per day
lbs/day = pounds per day
UOD = sum of $CBOD_u$ and $NBOD_u$

All projected simulations indicated that the ambient concentrations of ammonia nitrogen (maximum concentration of 0.14 mg/L) would be below the chronic criteria as determined under the 1999 updated criteria (minimum concentration of 1.44 mg/L). The results of the model projection simulations under each scenario are summarized as follows:

Scenario 1 – Under existing loadings, the projected summer critical conditions (7Q10 flow and temperature of 30.27° Celsius [C]) and winter critical conditions (7Q10 flow and temperature of 20.80°C) maintained the 5.0 mg/L DO standard throughout the reach of the subsegment. Therefore, no load reductions will be required under this TMDL. An explicit 10 percent margin of safety was included in the TMDL calculations.

Scenario 2 – Because no load reductions were required under summer or winter critical conditions in Scenario 1 to maintain the 5.0 mg/L DO standard, the results of Scenario 2 show how much Ultimate Oxygen Demand (UOD, the sum of $CBOD_u$ and ultimate nitrogen biochemical oxygen demand ($NBOD_u$) loadings can be increased above current loadings while maintaining the 5.0 mg/L DO standard.

Scenario 3 – Because no nonpoint source load reductions were required under summer or winter critical conditions in Scenario 1 to maintain the 5.0 mg/L DO standard, the results of Scenario 3 are the same as from Scenario 2.

Scenario 4 – Two flow regimes were evaluated under this scenario: a minimum diversion from the Mississippi River that maintains the 5.0 mg/L DO standard (Scenario 4a) and a maximum anticipated diversion of 1,000 cfs (Scenario 4b). At fully anticipated point source and nonpoint source loading, a minimum flow of 2.1 cfs was determined to be the minimum flow necessary to maintain the

5.0 mg/L DO standard in summer. The 5.0 mg/L DO standard would be maintained in winter even at zero flow.

At the maximum anticipated diversion of 1,000 cfs, no load reductions were required for summer critical conditions (7Q10 flow and temperature of 30.27°C) or for winter critical conditions (7Q10 flow and temperature of 20.80°C) to maintain the 5.0 mg/L DO standard. An explicit 10 percent margin of safety was included in the TMDL calculations.

<u>Scenario 5</u> – Because no load reductions were required for summer and winter critical conditions under Scenario 1, the load reductions in Scenarios 5a and 5b simply illustrate the relative impacts of loading types on hypothetical projections. Headwater loadings to the subsegment were not eliminated under either Scenario 5a or 5b. Under both summer and winter critical conditions, the impact of eliminating point sources to instream DO concentrations is minimal when compared to the results from Scenario 1. This observation underscores the small contribution of oxygen-demanding substances from existing point sources in the subsegment. The impact of eliminating nonpoint sources, other than the Mississippi River diversion, on projected instream DO concentrations was also minimal. Slight increases in instream DO concentrations (<0.3 mg/L) were apparent for that portion of the subsegment upstream of the Thibodaux weir (River Kilometer 54.0).

Much of coastal Louisiana was built by the process of delta formation through flooding and deposition of sediments by the rise and fall of the Mississippi River. Based on EPA's present knowledge, extensive areas of wetlands and coastal marshes are affected by a high rate of subsidence and degradation, primarily due to a lack of historical sediment and nutrients entering the wetlands. Subsidence is a natural process, but the building of levee systems has restricted the Mississippi River's course therefore preventing the natural cycle of the river and the natural process of delta formation. According to EPA, a large portion of the state's coastal wetlands have undergone and continue to undergo a severe deprivation of sediments and nutrients that has led quite literally to the breakup of the natural system. In addition, EPA believes that many of Louisiana's wetlands have become isolated from the riverine sources that created them and are becoming stagnant and starved for nutrients and organic and inorganic sediments. It should be pointed out that restoration of these eroding wetlands involves supplying nutrients to these wetlands through managed Mississippi River diversions.

The proposed TMDL for DO and nutrients for Bayou Lafourche presents a modified flow scenario, Model Scenario 4b. The modified flow of a 1,000 cfs diversion from the Mississippi River into Bayou Lafourche resulted in no required load reductions to maintain 5 mg/L of DO during summer and winter critical conditions as reported in Section 4. The Bayou Lafourche reintroduction proposed under the Louisiana Coastal Area, Louisiana, Ecosystem Restoration Study (LCA Study) could range from 1,000 to 5,000 cfs. EPA believes that flows greater than 1,000 cfs will result in flow increases that will enhance DO and decrease the likelihood of instream nutrient impairment in Bayou Lafourche. Based on EPA's calculations, if the proposed diversion from the Mississippi River into Bayou Lafourche approaches 5,000 cfs, the non-point source load allocation and TMDL for Model Scenario 4b will also be increased by 390,894 kg/day of UOD for the summer and 567,872 kg/day of UOD for the winter, respectively (EPA, 2005).

Based on EPA's current understanding, these diversion projects are supported by both State and Federal agencies, including EPA and the U.S. Army Corps of Engineers. The diversions are managed by the Corps of Engineers and the State, and the projects include post-diversion monitoring to determine effectiveness of the project and to monitor water quality conditions.

For additional information on this TMDL project, please contact Mr. Golam Mustafa, Technical Advisor (214-665-6576 or Mustafa.Golam@epa.gov), with the U.S. Environmental Protection Agency.